

(12) **UK Patent Application** (19) **GB** (11) **2 190 722** (13) **A**
(43) Application published 25 Nov 1987

(21) Application No **8612191**

(22) Date of filing **20 May 1986**

(71) Applicant
British Nuclear Fuels plc

(Incorporated in United Kingdom)

Risley, Warrington, Cheshire WA3 6AS

(72) Inventors
Kenneth John Wrigglesworth
James Frederic Knowles

(74) Agent and/or Address for Service
G J Owen,
Patents Branch, United Kingdom Atomic Energy
Authority, 11 Charles II Street, London SW1Y 4QP

(51) INT CL⁴
H04N 7/18

(52) Domestic classification (Edition I):
F2P G1
H4F AA D24 D27A2 D27R9

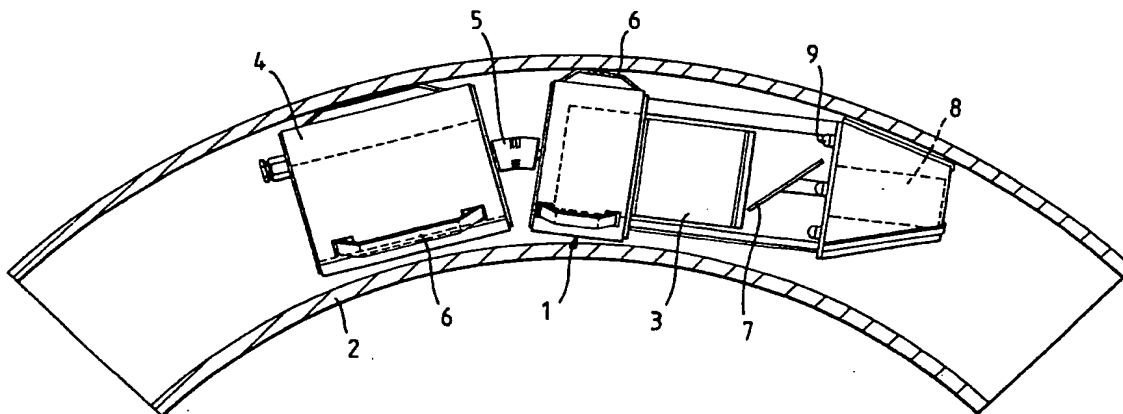
(56) Documents cited

GB A 2177278	GB A 2021351	US 4434427
GB A 2129653	GB 1097585	US 4272781
GB A 2122713	EP 0105418	US 4255762

(58) Field of search
F2P
H4F
Selected US specifications from IPC sub-classes B08B
H04N F16L

(54) **Pipework inspection apparatus**

(57) An apparatus for the internal inspection of pipework comprises a TV camera system in which the optical 3 and electronics 4 portions are physically separate units joined together by an articulated joint 5. This enables the camera system to negotiate bends in pipework.

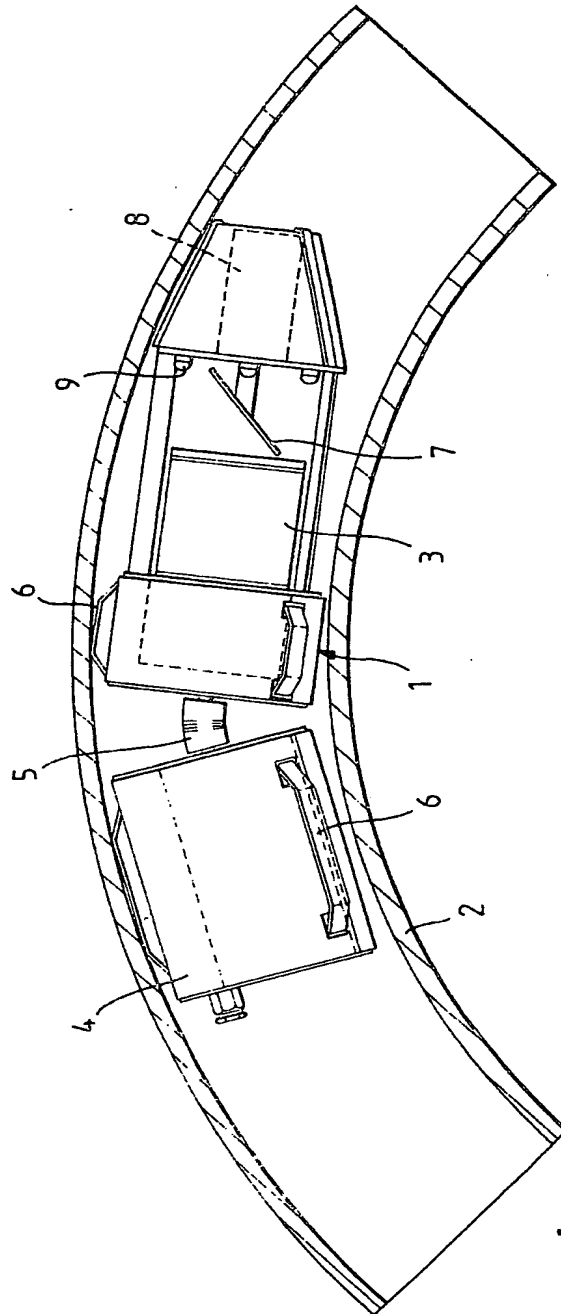


GB 2 190 722 A

20. 12191
DFA

2190722

1/1



SPECIFICATION

Pipework inspection apparatus

5 The present invention concerns pipework inspection apparatus.

10 It is desirable and often necessary to visually inspect weld roots at the abutting ends of pipe sections from within the bore of the pipe. Such inspections can be carried out on site by straight introsopes and fibre optic introsopes. The former cannot negotiate bends and the latter are both expensive and vulnerable to damage.

15 Existing TV camera systems are such that they are unable to negotiate sharp bends in pipes of certain minimum diameter on account of their length. Thus existing TV camera systems cannot negotiate 3D bends in pipework below 100mm diameter (D is diameter of pipework).

20 To overcome this problem and according to the present invention a TV camera system for the internal inspection of pipework comprises an optical portion and a separate electronics portion, the two portions being connected together by a flexible coupling. As a result the camera system can in effect bend itself around bends in the pipework. Conveniently, the optical portion comprises a rotatable mirror, lens, focus motor and imaging device and the electronics portion comprises the controls, power supplies and video output to recorders and/or monitors. The system can be pushed or pulled along the bore of the pipework.

25 An embodiment of a camera system for the internal inspection of pipework is illustrated, by way of example, in the accompanying diagrammatic drawing.

30 In the drawing, a TV camera system 1 is shown within a pipe 2. The system comprises an optical portion 3 and a control or electronics portion 4, the two portions being connected by a flexible coupling 5. As a result of the flexible coupling the system can negotiate bends in the pipe. The two portions are provided with guides 6 which slidably contact the bore of the pipe 2.

35 In order to provide a complete peripheral scan of the pipe bore, and for example to scan the root of a weld between abutting pipe lengths, a mirror 7, inclined preferably at 45° to the longitudinal axis of the optical portion 3, is mounted on the optical portion 3. The mirror 7 is rotatable by a drive motor 8 and lamps 9 are also provided at the leading end of the optical portion. Thus by rotating the mirror it is possible to scan the interior of the pipe through 360°.

40 It is further desirable to provide means for establishing the angular orientation of the camera system within the pipe upon rotation. This can be achieved by utilising a mercury switch that indicates a particular orientation and a

stepping motor that indicates its position relative to the particular orientation and provides a visual display on a control panel. Alternatively, a U-shaped tilt switch can be mounted on the mirror assembly. A vertical picture position is indicated by the tilt-switch being in an open position to illuminate a lamp on the control panel. This operation serves to establish the zero position. Upon rotation of the mirror an optical encoder, integral with the mirror, can provide a pulse for every sixteenth of a rotation of the motor shaft. The motor is coupled to a 2000:1 gearbox and consequently one complete revolution of the motor shaft will generate 32,000 pulses. The pulses are counted and scaled to give a display of position in degrees relative to the vertical.

45 The above are examples only of possible means for determining camera orientation within the pipe bore.

CLAIMS

1. Apparatus for the internal inspection of pipework comprising a TV camera system having an optical portion and a physically separate electronics portion, the two portions being connected by a flexible coupling.

2. Apparatus according to claim 1 in which the optical portion includes a rotatable mirror inclined at an angle to the longitudinal axis of the optical portion to perform a complete peripheral scan of a pipe bore.

3. Apparatus according to claim 1 or 2 including means for establishing the angular orientation of the camera system within the pipework.

4. Apparatus for the internal inspection of pipework substantially as herein described with reference to and as illustrated in the accompanying drawing.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd. Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

(12) UK Patent Application (19) GB (11) 2 190 722 (13) A

(43) Application published 25 Nov 1987

(21) Application No 8612191

(22) Date of filing 20 May 1986

(71) Applicant

British Nuclear Fuels plc

(Incorporated in United Kingdom)

Risley, Warrington, Cheshire WA3 6AS

(72) Inventors

Kenneth John Wigglesworth

James Frederic Knowles

(74) Agent and/or Address for Service

G J Owen,

Patents Branch, United Kingdom Atomic Energy

Authority, 11 Charles II Street, London SW1Y 4QP

(51) INT CL⁴

H04N 7/18

(52) Domestic classification (Edition I):

F2P G1

H4F AA D24 D27A2 D27R9

(56) Documents cited

GB A 2177278

GB A 2021351

US 4434427

GB A 2129653

GB 1097585

US 4272781

GB A 2122713

EP 0105418

US 4255762

(58) Field of search

F2P

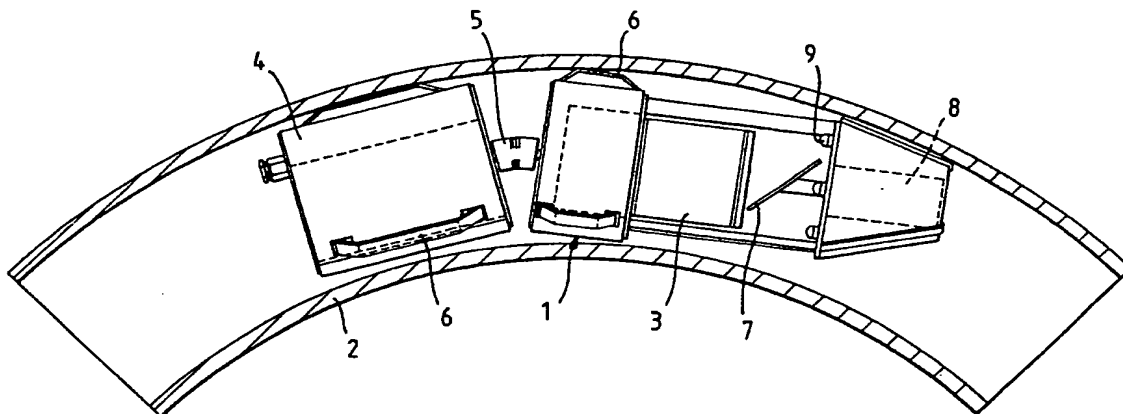
H4F

Selected US specifications from IPC sub-classes B08B

H04N F16L

(54) Pipework inspection apparatus

(57) An apparatus for the internal inspection of pipework comprises a TV camera system in which the optical 3 and electronics 4 portions are physically separate units joined together by an articulated joint 5. This enables the camera system to negotiate bends in pipework.

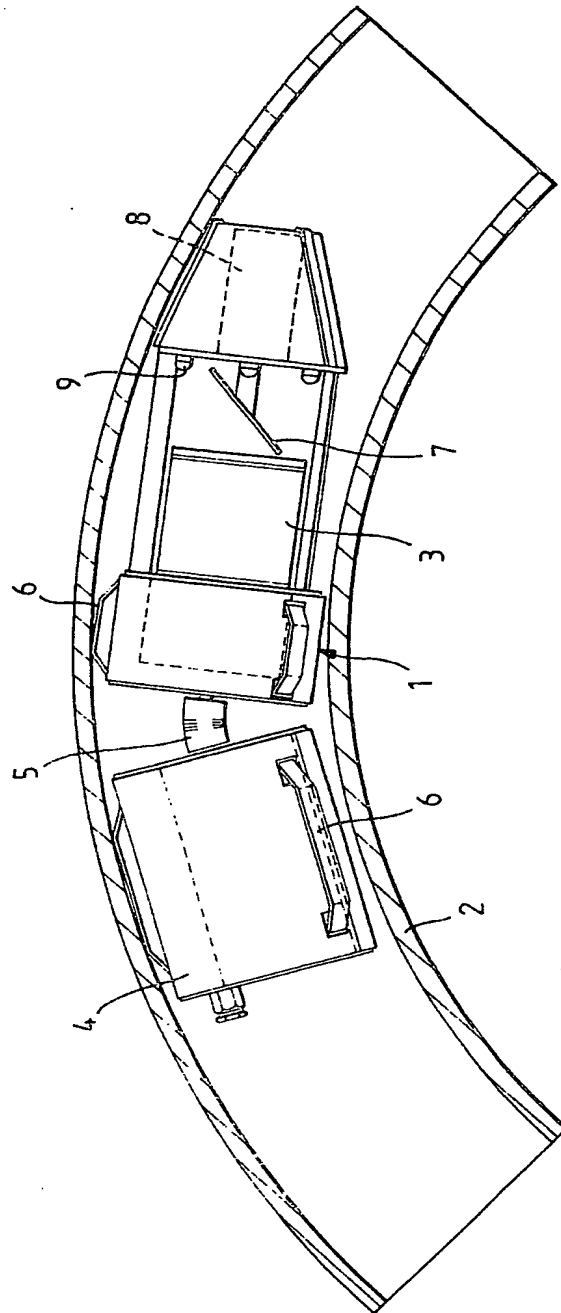


GB 2 190 722 A

20. 11. 72- 12191
D F A

2190722

1/1



SPECIFICATION

Pipework inspection apparatus

- 5 The present invention concerns pipework inspection apparatus.

It is desirable and often necessary to visually inspect weld roots at the abutting ends of pipe sections from within the bore of the pipe. Such inspections can be carried out on site by straight introsopes and fibre optic introsopes. The former cannot negotiate bends and the latter are both expensive and vulnerable to damage.

- 10 Existing TV camera systems are such that they are unable to negotiate sharp bends in pipes of certain minimum diameter on account of their length. Thus existing TV camera systems cannot negotiate 3D bends in pipework below 100mm diameter (D is diameter of pipework).

To overcome this problem and according to the present invention a TV camera system for the internal inspection of pipework comprises an optical portion and a separate electronics portion, the two portions being connected together by a flexible coupling. As a result the camera system can in effect bend itself around bends in the pipework. Conveniently, the optical portion comprises a rotatable mirror, lens, focus motor and imaging device and the electronics portion comprises the controls, power supplies and video output to recorders and/or monitors. The system can be pushed or pulled along the bore of the pipework.

An embodiment of a camera system for the internal inspection of pipework is illustrated, by way of example, in the accompanying diagrammatic drawing.

In the drawing, a TV camera system 1 is shown within a pipe 2. The system comprises an optical portion 3 and a control or electronics portion 4, the two portions being connected by a flexible coupling 5. As a result of the flexible coupling the system can negotiate bends in the pipe. The two portions are provided with guides 6 which slidably contact the bore of the pipe 2.

50 In order to provide a complete peripheral scan of the pipe bore, and for example to scan the root of a weld between abutting pipe lengths, a mirror 7, inclined preferably at 45° to the longitudinal axis of the optical portion 3, is mounted on the optical portion 3. The mirror 7 is rotatable by a drive motor 8 and lamps 9 are also provided at the leading end of the optical portion. Thus by rotating the mirror it is possible to scan the interior of the pipe through 360°.

60 It is further desirable to provide means for establishing the angular orientation of the camera system within the pipe upon rotation. This can be achieved by utilising a mercury switch that indicates a particular orientation and a

stepping motor that indicates its position relative to the particular orientation and provides a visual display on a control panel. Alternatively, a U-shaped tilt switch can be mounted on the mirror assembly. A vertical picture position is indicated by the tilt-switch being in an open position to illuminate a lamp on the control panel. This operation serves to establish the zero position. Upon rotation of the mirror an optical encoder, integral with the mirror, can provide a pulse for every sixteenth of a rotation of the motor shaft. The motor is coupled to a 2000:1 gearbox and consequently one complete revolution of the motor shaft will generate 32,000 pulses. The pulses are counted and scaled to give a display of position in degrees relative to the vertical.

The above are examples only of possible means for determining camera orientation within the pipe bore.

CLAIMS

1. Apparatus for the internal inspection of pipework comprising a TV camera system having an optical portion and a physically separate electronics portion, the two portions being connected by a flexible coupling.
2. Apparatus according to claim 1 in which the optical portion includes a rotatable mirror inclined at an angle to the longitudinal axis of the optical portion to perform a complete peripheral scan of a pipe bore.
3. Apparatus according to claim 1 or 2 including means for establishing the angular orientation of the camera system within the pipework.
4. Apparatus for the internal inspection of pipework substantially as herein described with reference to and as illustrated in the accompanying drawing.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd. Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.